International University of Africa

Faculty of pure and applied sciences

Design a Biological Phantom for Human Breast (mammographic)

Thesis submitted in partial fulfillment of academic requirement for the degree of the master's

Presented by:

Naglaa Ahmed Abdalla

Supervised by:

Dr. Fawzia Elsadig Mohammed Elbashir

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الإستهلال

قال الله تعالى:

(اقرأ بأسم ربك الذي خلق (1) خلق الإنسان من علق (2)اقرا وربك الأكرم (3)الذي علم بالقلم(4)علم الانسان ما لم يعلم (5)).

سورة العلق: الآيه (1-5)

Dedication

I would like to dedicate this work to my family and friends

Acknowledgement

I am greatly indebted to my supervisor Dr. Fawzia Elsadig for her all positive guidance , help and encouragement that help me to make me dreams a reality.

Without her help and support this thesis will never see the light in this shape .

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ABSTRACT

The goal of mammography is the detection, characterization, and evaluation of findings suggestive of breast cancer and other breast diseases. Annual screening mammography of age-appropriate asymptomatic women is currently the only imaging modality that has been proven to significantly reduce breast cancer mortality. A screening mammogram is an X-ray examination of the breast of an asymptomatic woman ,to perform QC chards . Exposure to high doses could be reason for suffering rather than diagnoses. Therefore, design biological phantom with similar properties to the actual human breast. This phantom helps radiology professional to ensure that their mammographic system is producing highest quality images.

The main objective of this research, to develop a new quality-control biological phantom composed of natural materials useful for mammography imaging modality. Two different locally available materials were tested using (GC-MS , Densitometer , mammography machine).The proposed phantom in this study was designed using egg white , egg shell , Beeswax and Animal fat to mimic the breast fat layer .Holder was designed with dimensions 10cm,10 cm and 4 cm from transparent plastic material.

Two Phantoms from materials that are available and cheap were Compared with APG Phantom .Good results of optical density average1.231 kg/m3was obtained from phantom one agree with results from patients of age less than 40 years. Phantom tow also obtained acceptable results average 1.141kg/m3in compared with a phantom APG from a Literature Review and also a great agreement with results from patients of age greater more than 40 years.

The study recommends future studies for mammography dosimetry and quality control measurements by using these phantoms.

المستخلص

الهدف من التصوير الاشعاعي للثدي هو الكشف ,وتوصيف وتقييم النتائج التي تدل علي سرطان الثدي وغيره من امراض الثدي.سنوياً التصوير الاشعاعي للثدي يحصر فئات عمرية من النساء ذات الامراض عديمه الاعراض وهو حالياً طريقة التصوير الوحيدة التي ثبتت لخفض كبير في معدل الوفيات من سرطان الثدي,يتم ذلك عبر ضبط الجودة . التعرض لجرعات عاليه يمكن ان يكون سبب معاناة بدلاً من التشخيص.

هذا الفانتوم الحيوي ذو خصائص مماثلة لسرطان الثدي الطبيعي , هذا الفانتوم يساعد الاشعة المهنية لضمان ان النظام بالاشعة ينتج الصورة في اعلي مستوي جودة.

وكان الهدف الرئيسي من هذا البحث هو تطوير تصميم مجسم حيوي جديد لمراقبة جودة أجهزة تصوير الثدي بالاشعة محلياً مما يساهم في الجانب الاقتصادي ويقلل تكلفة شرائه من الخارج .ولعمل ذلك قمنا بأختبار مجموعة من المواد بعدد من أجهزة القياس بأستخدام جهاز تصوير الثدي بالأشعة وكاشف لقياس الكثافة وجهاز تحليل المركبات, المواد الطبيعيه المستخدمة (بياض وقشر البيض , وشمع النحل ,والشحوم الحيوانية) وذلك لتقليد المواد الاساسية المكونة للثدي الطبيعي , كما تم وضع هذه المواد في حاوية بلاستيكيه شفافه .

وقد كانت نتائج هذا البحث ناجحه , حيث تم تصميم مجسمين بمواد طبيعيه ورخيصة ومتوفرة محلياً, وقد كانت نتائج المجسم الاول مقبولةحيث اعطي متوسط كثافة ضوئيه 1.231 كيلوجرام\متر^3 مقارنة مع صورالمرضي ذو الاعمار الاقل من 40 سنة .

وعند أختبار المجسم الثاني, أعطي متوسط كثافة ضوئيه 1.141كيلوجرام\متر^3 وهي اكثر دقه وجودة من المجسم الاول مقارنة بالمجسم المعياري (APG) والمرضي ذو الاعمار 40 سنه فما فوق .

نوصي بأستخدام هذاالفانتوم في قياس الجرعة الاشعاعية وقياس جودة الصورة QC.

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List O F Abbreviation

SEM	Screen Film Mammography
NCI	National Cancer Institute
ACS	American Cancer Society
APG	Applied Physics Group
GC-MS	Gas Chromatography –Mass Spectrometry
TDLUS	Terminal Ductal lobular Units
MRI	Magnetic Resonance Imaging
AEC	Automatic Exposure Control
QC	Quality Control
ACR	American Collage of Radiology
BRTES	Breast Tissue Equivalent Series
MQSA	Mammography Quality Standards act
TLD	Thermo luminescent Dosimeter
KERMA (Ki)	Kinetic Energy Released Per Unit Mass
DBT	Digital Breast Tom synthesis
AGD	Average Glandular Breast Dose
GD	Glandular Dose

PVAL	Polyvinyl Alcohol
RCF	Relative Centrifugal Force
Gy	Gray
NCAT	4D NURBS-based Cardiac-Torso
GATE	Geant4 Application for Tomographic Emission
PMMA	Polymethyl methacrylate